

CLAIMS

1. An apparatus comprising:
 - a die mounted on a substrate, the die being connected to the substrate by a plurality of wires; and
 - a mold cap encapsulating the die and the plurality of wires, the mold cap comprising an electrically insulating portion encapsulating the wires and at least a portion of the die and a thermally conductive portion overmolded on the die and the electrically insulating portion.
2. The apparatus of claim 1 wherein the die comprises an integrated circuit.
3. The apparatus of claim 1 wherein the electrically insulating material comprises a curable resin, a crosslinker, a catalyst, and a reinforcing filler.
4. The apparatus of claim 3 wherein the reinforcing filler comprises silica, alumina, zinc oxide, talc, or combinations thereof.
5. The apparatus of claim 1 wherein the thermally conductive material comprises a curable resin, a crosslinker, a catalyst, and a metal filler.
6. The apparatus of claim 5 wherein the metal filler comprises aluminum, silver, copper, gold, or combinations or alloys thereof.
7. The apparatus of claim 1 wherein the electrically insulating portion encapsulates the wires and the entire die.
8. The apparatus of claim 1 wherein the electrically insulating portion encapsulates the wires and a perimeter of the die.
9. The apparatus of claim 1, further comprising a heat dissipation device attached to, and in thermal contact with, the thermally conductive material.

10. An apparatus comprising:

a stack of dies mounted on a substrate, the stack including a first die attached to the substrate and at least one additional die stacked thereon;

a plurality of wires connecting at least one of the stacked dies to the substrate or to another die in the stack; and

a mold cap encapsulating the wires and the plurality of stacked dies, the mold cap comprising an electrically insulating portion encapsulating the wires and at least a portion of the stacked dies and a thermally conductive portion overmolded on the stack of dies and the electrically insulating portion.

11. The apparatus of claim 10 wherein at least one of the stacked dies comprises an integrated circuit.

12. The apparatus of claim 10 wherein the first die is flip-chip bonded to the substrate.

13. The apparatus of claim 10 wherein the electrically insulating material comprises a curable resin, a crosslinker, a catalyst, and a reinforcing filler.

14. The apparatus of claim 10 wherein the reinforcing filler comprises silica, alumina, zinc oxide, talc, or combinations thereof.

15. The apparatus of claim 10 wherein the resin comprises a curable resin, a crosslinker, a catalyst, and a metal filler.

16. The apparatus of claim 15 wherein the metal filler comprises aluminum, silver, copper, gold, or combinations or alloys thereof.

17. The apparatus of claim 10 wherein the electrically insulating portion encapsulates the wires and the entire stack of dies.

18. The apparatus of claim 10 wherein the electrically insulating portion encapsulates the wires and the perimeter of the dies in the stack of dies.
19. The apparatus of claim 10, further comprising a heat dissipation device attached to, and in thermal contact with, the thermally conductive material.
20. A process comprising:
 - providing a die connected to a substrate by a plurality of wires;
 - encapsulating the wires and at least a portion of the die in an electrically insulating material; and
 - encapsulating the die, the wires and the electrically insulating material in a thermally conductive material.
21. The process of claim 20 wherein encapsulating the wires and at least a portion of the die in an electrically insulating material comprises applying the electrically insulating material around a perimeter of the die by dispensing, spraying, screen printing, transfer molding, or injection molding.
22. The process of claim 21 wherein encapsulating the wires and at least a portion of the die in an electrically insulating material further comprises curing the electrically insulating material using thermal, UV, laser, or microwave curing.
23. The process of claim 20 wherein encapsulating the die, the wires and the electrically insulating material in a thermally conductive material comprises applying the thermally conductive material on the die, the wires and the electrically insulating material by dispensing, spraying, screen printing, transfer molding, or injection molding.
24. The process of claim 23 wherein encapsulating the die, the wires and the electrically insulating material in a thermally conductive material further

comprises curing the electrically insulating material using thermal, UV, laser, or microwave curing.

25. The process of claim 20 wherein the thermally conductive material comprises a curable resin, a crosslinker, a catalyst, and a metal filler.
26. The process of claim 25 wherein the metal filler comprises aluminum, silver, copper, gold, or combinations or alloys thereof.
27. The process of claim 20 wherein the die comprises an integrated circuit.
28. A process comprising:
 - providing a stack of dies, the stack including a first die attached to a substrate and at least one additional die stacked thereon;
 - encapsulating the wires and at least a portion of the stack of dies in an electrically insulating material; and
 - encapsulating the stack of dies, the wires and the electrically insulating material in a thermally conductive material.
29. The process of claim 28 wherein encapsulating the wires and at least a portion of the stack of dies in an electrically insulating material comprises applying the electrically insulating material around a perimeter of the stack of dies by dispensing, spraying, screen printing, transfer molding, or injection molding.
30. The process of claim 29 wherein the electrically insulating material is thinly applied to the wires and the perimeter of the stack of dies.
31. The process of claim 29 wherein encapsulating the wires and at least a portion of the stack of dies in an electrically insulating material further

comprises curing the electrically insulating material using thermal, UV, laser, or microwave curing.

32. The process of claim 28 wherein encapsulating the stack of dies, the wires and the electrically insulating material in a thermally conductive material comprises applying the thermally conductive material on the stack of dies, the wires and the electrically insulating material by dispensing, spraying, screen printing, transfer molding, or injection molding.
33. The process of claim 32 wherein encapsulating the stack of dies, the wires and the electrically insulating material in a thermally conductive material further comprises curing the electrically insulating material using thermal, UV, laser, or microwave curing.
34. The process of claim 28 wherein the thermally conductive material comprises a curable resin, a crosslinker, a catalyst, and a metal filler.
35. The process of claim 28 wherein the metal filler comprises aluminum, silver, copper, gold, or combinations or alloys thereof.
36. The process of claim 28 wherein the first die is flip-chip bonded to the substrate.
37. The process of claim 28 wherein at least one of the stacked dies comprises an integrated circuit.